



THE UNIVERSITY *of* EDINBURGH

Edinburgh Research Explorer

Intelligence moderates how education mediates the effect of social background on own attained occupational position

Citation for published version:

Sorjonen, K, Hemmingsson, T, Deary, IJ & Melin, B 2013, 'Intelligence moderates how education mediates the effect of social background on own attained occupational position', *Intelligence*, vol. 41, no. 5, pp. 529-536. <https://doi.org/10.1016/j.intell.2013.07.007>

Digital Object Identifier (DOI):

[10.1016/j.intell.2013.07.007](https://doi.org/10.1016/j.intell.2013.07.007)

Link:

[Link to publication record in Edinburgh Research Explorer](#)

Document Version:

Peer reviewed version

Published In:

Intelligence

Publisher Rights Statement:

© Intelligence moderates how education mediates the effect of social background on own attained occupational position. / Sorjonen, Kimmo; Hemmingsson, Tomas; Deary, Ian J.; Melin, Bo.
In: Intelligence, Vol. 41, No. 5, 10.2013, p. 529-536.

General rights

Copyright for the publications made accessible via the Edinburgh Research Explorer is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy

The University of Edinburgh has made every reasonable effort to ensure that Edinburgh Research Explorer content complies with UK legislation. If you believe that the public display of this file breaches copyright please contact openaccess@ed.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.



Abstract

A positive cognitive ability \times motivation interaction effect on performance has been suggested. In the area of working life, attained occupational position could be seen as a measure of performance and earlier studies have indicated that the commonly found association between social background and own attained occupational position might be mediated through attained level of education. In the present study, it is hypothesized that both social background and level of education might be indicative of educational/occupational motivation and, therefore, the importance of level of education as a mediator should increase with increasing intelligence. This hypothesis was confirmed in a cohort of Swedish men born 1949-1951 ($N = 49,246$). This moderated mediation seems mainly to be due to a strengthening of the association between attained level of education and attained occupational position with increasing intelligence. The association between attained level of education and attained occupational position was found to be more linear among men with high intelligence scores and more exponential among men with low scores. It is discussed that this might be due to a low validity in the measurement of intelligence among men who receive a low intelligence score at conscription but who, nonetheless, go on and attain a high level of education.

Keywords: education, intelligence, moderated mediation, occupational position, social background

Intelligence Moderates How Education Mediates the Effect of Social Background on Own Attained Occupational Position

It has been suggested that there should be a positive cognitive ability \times motivation interaction effect when predicting performance (e.g. Vroom, 1964), which would mean, assuming that the main effects tend to be positive, that the effect of ability on performance is stronger at high compared with low levels of motivation, and that the effect of motivation on performance is stronger at high compared with low levels of ability. This notion has received some empirical support. In a large sample from the National Longitudinal Survey of Youth (NLSY), Ganzach, Saporta, and Weber (2000) found that educational motivation interacted positively with intelligence, measured with the Armed Forces Qualifying Test (AFQT), in its effect on the odds for high school graduation. Similarly, Hirschfeld, Lawson, and Mossholder (2004) found that motivation interacted positively with Scholastic Aptitude Test (SAT) scores when predicting grade point averages (GPAs) in a sample of undergraduate students. However, this interaction was found only when motivation was assessed with a more specific measure of academic achievement motivation rather than a measure of general achievement motivation. Yeo and Neal (2004) found a significant three way interaction effect between cognitive ability, effort, and practice on performance in an air traffic control task. The positive effort \times practice interaction effect was stronger for individuals with high cognitive ability than it was for those with lower scores. However, when using the personality characteristics need-for-achievement and dependability as conceptualizations of motivation, Sackett, Gruys, and Ellingson (1998) found no ability \times motivation interaction effect on job performance in samples of army personnel, managerial employees, entry-level bakery employees, and employees in a financial institution.

According to Campbell (1990), individual difference in performance is a function of three, and only three, major determinants: (1) Declarative knowledge, which is knowledge about facts and things, and an understanding of a given task's requirements; (2) procedural

knowledge and skill, which include cognitive skill, psychomotor skill, and interpersonal skill; and (3) motivation, which is the combined effect of three choices: (a) the choice to expend effort; (b) the choice of the level of effort to expend, and (c) the choice to persist at that level of effort. This model has received empirical support, for example in a sample of 1580 soldiers with eight different military occupational specialties (McCloy, Campbell, & Cudeck, 1994).

In a related line of research, Schmidt and colleagues have looked at how subjects allocate time to competing tasks. They have, for example, found that people tend to allocate more time to a rewarded goal than to one that is not rewarded (Schmidt & DeShon, 2007). When people have two equally valued goals, they tend to allocate more time to the goal that is closest to attainment if both goals are judged as difficult to attain. If both goals are judged as easy to attain, on the other hand, more time is allocated to the goal that is furthest from attainment (Schmidt & Dolis, 2009). Schmidt, Dolis, and Tolli (2009) found that when goal progress was only due the performers' actions, they tended to allocate more time to the goal that was closest to attainment early on and to the goal furthest from attainment as the deadline neared. In a condition where goal progress was also influenced by unpredictable external factors, this time to deadline \times distance from goal attainment interaction effect on time allocation was reversed. In this latter condition, it was also found that people with a strong mastery orientation tended to allocate more time to the goal furthest from attainment, while those with a strong avoidance orientation tended to allocate more time to the goal closest to attainment.

Attained occupational position could be seen as a measure of performance in the area of working life and intelligence or cognitive ability has been indicated as one of the best predictors of both attained occupational position (Ball, 1938; Deary et al., 2005; Herrnstein & Murray, 1994; McCall, 1977; Nettle, 2003; Strenze, 2007) and level of education (e.g. Sorjonen, Hemmingsson, Lundin, Falkstedt, & Melin, 2012; von Stumm, Macintyre, Batty, Clark, & Deary, 2010). Besides intelligence, a person's level of education probably also

indicates to what extent he or she is motivated to perform in the area of working life, and level of education has often been found to have an even stronger unique effect on attained occupational, or a more general socioeconomic, position than intelligence (e.g. Johnson, Brett, & Deary, 2010; Schoon, 2008; Sorjonen et al., 2012).

Studies have also found that social background, operationalized for instance as the status of the father's occupational position, is associated with peoples' own attained occupational position (e.g. Breen & Goldthorpe, 1999, 2001), even after adjusting for the positive association between a more professional background and higher intelligence (e.g. Deary et al., 2005; Sorjonen et al., 2012). Some suggest that this association between social background and attained occupational position is mediated through level of education (e.g. Blau & Duncan, 1967; Härkönen & Bihagen, 2011; Ishida, Müller, & Ridge, 1995; Warren, Hauser, & Sheridan, 2002). A positive association between a more professional background and a higher level of education has been shown, even after adjusting for intelligence (e.g. Schoon, 2008; Sorjonen et al., 2012). This could, for instance, be due to a higher educational motivation among those with a more professional background, which, in its turn, could be attributable to greater perceived expectations from parents and others and/or greater perceived chances to succeed.

If we assume that level of education mediates the association between social background and attained occupational position, the size of this mediated effect is the product of two effects: (1) of social background on level of education, and (2) of level of education on attained occupational position when adjusting for social background. However, if, as discussed above, both a more professional background and a high level of education are positively associated with a higher educational/occupational motivation, and if we assume that there is a positive ability \times motivation interaction effect on performance, both of these effects should increase in strength with increasing intelligence. This would mean that the

importance of education as a mediator of the association between social background and own attained occupational position should increase with increasing intelligence.

The assumption that both social background and attained educational level are indicative of educational/occupational motivation might be seen as problematic and more direct measures of motivation would, of course, have been preferable. However, this assumption concur with Schoon (2008), who found positive associations between school motivation and a more professional background and attained level of education in two British cohorts. It could be argued that level of education should be indicative of at least one of Campbell's (1990) three motivation related choices described above, namely the choice to persist at a certain level of effort.

Method

Subjects

The present study was based on data from 49,246 Swedish males, born between 1949 and 1951. They were conscripted for compulsory military service in 1969/70. At that time, only 2–3% of all Swedish men were exempted from conscription, in most cases owing to severe handicaps or congenital disorders.

Assessment of intelligence

Four separate IQ tests were performed, mainly in order to assess the conscripts' suitability for education as officers. According to Ross (1988), the first and second tests measured logical inductive and verbal intelligence, whereas the third test measured spatial intelligence, and the last test measured technical understanding. The raw scores on all four tests were standardized to a scale from one to nine and, on all four, a higher value indicates a higher level of the cognitive ability (Ross, 1988). In the next step, these four values were added into a sum and then transformed into a new standard-nine scale as a measure of general ability (Carlstedt, 2000), which we hereinafter refer to as intelligence. This last step is warranted by the fact that the correlations between the four measures ranged from .50 to .75

(Sorjonen et al., 2012). The nine resulting levels of intelligence correspond approximately to the IQ bands of: < 74, 74-81, 82-89, 90-95, 96-104, 105-110, 111-118, 119-126, and > 126.

Census data on occupational position and education

The subjects of the present study were linked to information from the National Population and Housing Census to obtain their father's occupational position in 1960, when the subjects were between nine and eleven years old. Based on self-reported occupation, a classification into the following seven groups was conducted at Statistics Sweden: (1) unskilled workers, (2) skilled workers, (3) assistant non-manual employees, (4) non-manual employees at intermediate level, (5) non-manual employees at higher level, (6) farmers, (7) those for whom no occupation was reported (e.g. early retired or unemployed). In Sweden farmers are in general self-employed and it is considered unclear how they compare hierarchically with manual workers and non-manual employees. Therefore, conscripts whose fathers were farmers or occupationally unclassified ($n = 6536$), were not given any value on this variable. However, they were included in the analyses that did not include father's occupational position as a predictor.

Information on the subjects' self-reported level of education and attained occupational position in 1990, based on self-reported occupation, was obtained from the National Population and Housing Census of that year. The seven levels of education were: (1) primary school less than nine years, (2) primary school nine to ten years, (3) upper secondary school up to two years, (4) upper secondary school more than two but not more than three years, (5) college or university less than three years, (6) college or university three years or more, (7) postgraduate studies. The classification of occupational position was the same as in the census in 1960 presented above. Again, subjects were not given any value if they were farmers or occupationally unclassified ($n = 8258$).

Statistical analyses

Using the Bayesian estimation module in Amos 20 statistical software (see Arbuckle, 2011, for a description) the following effects (Figure 1, Left panel) and their standard errors were calculated separately for the nine levels of intelligence in more than 90,000 subsamples drawn from the whole sample after replacement of the previous subsample: (a) the crude effect of father's occupational position on own attained level of education; (b) the effect of level of education on own attained occupational position when adjusting for father's occupational position; (c) the crude effect of father's occupational position on own attained occupational position; (c') the effect of father's occupational position on own attained occupational position when adjusting for level of education. The product of a and b (as well as the difference between c and c') gives the size of the mediated effect through level of education and the ratio $(a \times b) / c$ gives how much of the total effect of father's occupational position on own attained occupational position is mediated through level of education. Pairwise comparisons of the effects between levels of intelligence were conducted by calculating the difference between the effects in more than 90,000 subsamples with the levels of intelligence in question. If the difference was either positive or negative in more than 99.9 % of these subsamples, the difference was considered as significant. Descriptive statistics, analysis of variance with Tukey HSD Post Hoc Test, and various regression effects were also calculated, using R 2.15.2 statistical software (R Core Team, 2012). Due to the many tests, the level of significance was set at .001. Given the large sample, the analyses should still have an acceptable power. As an example, in a sample of 49,246 individuals, it is enough with a correlation of .015 for it to be significant at the $p = .001$ level.

Results and Discussion

Descriptive statistics for father's occupational position (FOP), level of education, and own attained occupational position (AOP) are presented in Table 1 separately for the nine

levels of intelligence. It is evident that intelligence has a positive association with all three variables.

Table 1

Mean (and Standard Deviation) Father's Occupational Position (FOP), Level of Education, and Own Attained Occupational Position (AOP), Separately for the Nine Levels of Intelligence.

IQ	<i>n</i>	FOP	Education	AOP
All	49,246	2.30 (1.31)	3.52 (1.56)	2.76 (1.39)
< 74	1966	1.65 (0.98) _a	2.06 (0.99) _a	1.60 (0.84) _a
74-81	2630	1.76 (1.05) _a	2.31 (1.09) _b	1.77 (0.95) _b
82-89	4823	1.80 (1.05) _a	2.53 (1.14) _c	1.96 (1.09) _c
90-95	7017	1.99 (1.16) _d	2.82 (1.22) _d	2.21 (1.20) _d
96-104	8486	2.13 (1.23) _e	3.19 (1.34) _e	2.53 (1.30) _e
105-110	8733	2.37 (1.31) _f	3.76 (1.42) _f	2.95 (1.34) _f
111-118	7338	2.63 (1.36) _g	4.24 (1.40) _g	3.32 (1.32) _g
119-126	5052	2.86 (1.37) _h	4.70 (1.32) _h	3.62 (1.24) _h
> 126	3201	3.09 (1.38) _i	5.17 (1.14) _i	3.92 (1.08) _i

Note: In each column, if two values have a subscript in common the difference between the means is not significant ($p > .001$) according to Tukey HSD Post Hoc Test.

The nine levels of intelligence (Stanine scores) were transformed to corresponding IQ scores with the formula $IQ = 62.86 + 7.43 \times \text{Stanine score}$, as this formula gave the best fit when predicting the midrange IQ scores from Stanine scores 2-8 in a regression model ($R^2 = 1$). Mean IQ is presented in Table 2, separately for the five levels of father's occupational position, seven levels of attained education, and five levels of own attained occupational position. It is obvious that an increase in all three of these variables is associated with an increase in mean IQ.

Table 2

Mean (and Standard Deviation) IQ, Separately for the Five Levels of Father's Occupational Position (FOP), Seven Levels of Attained Education, and Five Levels of Own Attained Occupational Position (AOP).

Level	FOP		Education		AOP	
	<i>n</i>	Mean IQ	<i>n</i>	Mean IQ	<i>n</i>	Mean IQ
All	42,785	103.23 (15.22)	47,575	102.85 (15.27)	41,063	103.16 (15.15)
1	16,351	98.90 (14.93) _a	4872	89.19 (12.40) _a	10,764	95.52 (14.29) _a
2	10,547	101.23 (14.60) _b	7618	95.33 (13.51) _b	9051	96.61 (13.41) _b
3	4997	106.76 (14.17) _c	13,945	98.61 (13.17) _c	5354	105.54 (13.39) _c
4	8306	109.33 (13.97) _d	7990	107.65 (13.11) _d	11,190	109.83 (12.89) _d
5	2584	112.36 (13.42) _e	5702	111.16 (12.02) _e	4704	114.64 (11.44) _e
6	-	-	6995	115.58 (10.97) _f	-	-
7	-	-	453	121.17 (9.33) _g	-	-

Note: In the columns with means, if two values have a subscript in common the difference between the means is not significant ($p > .001$) according to Tukey HSD Post Hoc Test.

The size of the effects illustrated in the Left panel in Figure 1 is presented in Table 3 separately for the nine levels of intelligence. The effects of father's occupational position on level of education (a), of education on own attained occupational position (b), and the mediated effect of father's occupational position on own attained occupational position through level of education ($a \times b$), all increase with increasing intelligence (the linear trends, which is the change in these effects for an increase in intelligence by one level, are positive and significant, see last row in Table 3). The percentage of the total effect of father's occupational position on own attained occupational position that is mediated by level of education (% Med) also tends to increase with increasing intelligence, but the linear trend is not significant. The effect of father's occupational position on own attained occupational position, both crude (c) and when adjusting for level of education (c'), show a curvilinear

association with intelligence (the linear trends are not significant and the effects are strongest for intermediate levels of intelligence, IQ 96-110 for c and IQ 90-104 for c' , see Table 3).

Table 3

Unstandardized Effects (and Standard Errors) of Father's Occupational Position on Education (a), and on Own Attained Occupational Position (Both Crude (c) and Adjusted for Education (c')), as Well as the Effect of Education (Adjusted for Father's Occupational Position) on Own Attained Occupational Position (b), Separately for the Different Levels of Intelligence. The Size of the Mediated Effect ($a \times b$) and How Much of the Total Effect of Father's Occupational Position on Own Attained Occupational Position is Mediated Through Education (% Med) are Also Given. In the Last Row the Linear Trend (the Change in the Effect in Question for One Steps Increase in Level of Intelligence) is Given.

IQ	Effect					% Med
	a	b	c	c'	$a \times b$	
All	.414(.005)*	.523(.004)*	.317(.005)*	.099(.005)*	.217(.003)*	68.7*
< 74	.156(.026) _a *	.211(.022) _a *	.072(.025) _a	.039(.024) _{ab}	.033(.006) _a *	50.5 _{abc}
74-81	.160(.023) _a *	.246(.018) _a *	.085(.021) _a *	.040(.020) _{ab}	.039(.006) _a *	53.9 _{abc} *
82-89	.152(.017) _a *	.261(.014) _a *	.138(.018) _{abc} *	.095(.017) _b *	.040(.005) _a *	29.9 _a *
90-95	.202(.014) _{ab} *	.377(.012) _b *	.186(.014) _{bcd} *	.107(.014) _b *	.076(.006) _b *	41.8 _a *
96-104	.251(.012) _{bc} *	.455(.010) _c *	.219(.013) _d *	.105(.012) _b *	.114(.006) _c *	52.4 _{ab} *
105-110	.260(.012) _c *	.499(.010) _d *	.212(.012) _d *	.085(.011) _b *	.130(.007) _c *	60.8 _{bc} *
111-118	.253(.013) _{bc} *	.522(.010) _d *	.188(.013) _{cd} *	.057(.011) _{ab} *	.132(.007) _c *	70.1 _c *
119-126	.258(.014) _{bc} *	.492(.013) _{cd} *	.185(.014) _{bcd} *	.055(.013) _{ab} *	.127(.008) _c *	69.9 _{bc} *
> 126	.221(.015) _{abc} *	.505(.017) _{cd} *	.118(.016) _{ab} *	.008(.014) _a	.111(.008) _{bc} *	94.4 _c *
Lin.Tre	.022(.002)*	.023(.002)*	.006(.003)	-.003(.002)	.014(.003)*	5.4

* $p < .001$; Note: In each column, if two values have a subscript in common, or if one of the values lack a subscript, the difference between the effects is not significant ($p > .001$).

Additional analyses revealed that the effect of intelligence on education and the effect of education on attained occupational position, when adjusting for intelligence, have a similar size across the levels of father's occupational position (Figure available on request from the first author). Hence, father's occupational position does not moderate how education mediates the effect of intelligence on attained occupational position.

As the measure of attained occupational position might be considered as rather crude and not very well suited for linear analyzes, the effect of level of education on the odds for upward and downward social mobility, and how this effect is moderated by intelligence, was analyzed with binary logistic regression. Subjects were considered to have experienced upward social mobility if their occupational position in 1990 was higher, on the scale with five levels presented in the method section, than their father's occupational position was in 1960, and downward social mobility if their occupational position was lower. As social background has a strong restricting effect on how much room there is for upward/downward mobility, the effects were calculated while adjusting for father's occupational position. These analyzes revealed a similar picture as the linear analyzes: The odds for upward mobility increases, and the odds for downward mobility decreases, with increasing level of education. However, these associations strengthen with increasing intelligence (Table 4).

Table 4

The Effect of Level of Education on the Odds for Upward and Downward Social Mobility (with 99.9 % CI), Separately for the Different Levels of Intelligence. In the Last Row the Linear Trend (the Change in the Effect of Education on the Odds for Upward/Downward Mobility for One Steps Increase in Level of Intelligence) is Given. All Effects are Adjusted for Father's Occupational Position.

IQ	Upward	Downward
----	--------	----------

All	2.222 (2.143-2.304)	0.445 (0.426-0.465)
< 74	1.683 (1.314-2.154) _{abc}	0.695 (0.493-0.980) _a
74-81	1.578 (1.320-1.887) _{ab}	0.638 (0.497-0.818) _{ab}
82-89	1.482 (1.316-1.669) _a	0.648 (0.548-0.767) _a
90-95	1.767 (1.599-1.953) _{bcd}	0.597 (0.528-0.676) _b
96-104	1.949 (1.785-2.128) _{cde}	0.495 (0.442-0.553) _c
105-110	2.131 (1.951-2.328) _e	0.473 (0.427-0.525) _{cd}
111-118	2.218 (2.002-2.456) _e	0.437 (0.388-0.492) _d
119-126	2.476 (2.156-2.843) _e	0.460 (0.398-0.532) _{cd}
> 126	2.733 (2.192-3.409) _{de}	0.380 (0.304-0.475) _d
Lin.Tre.	1.030 (1.015-1.045)	0.926 (0.910-0.942)

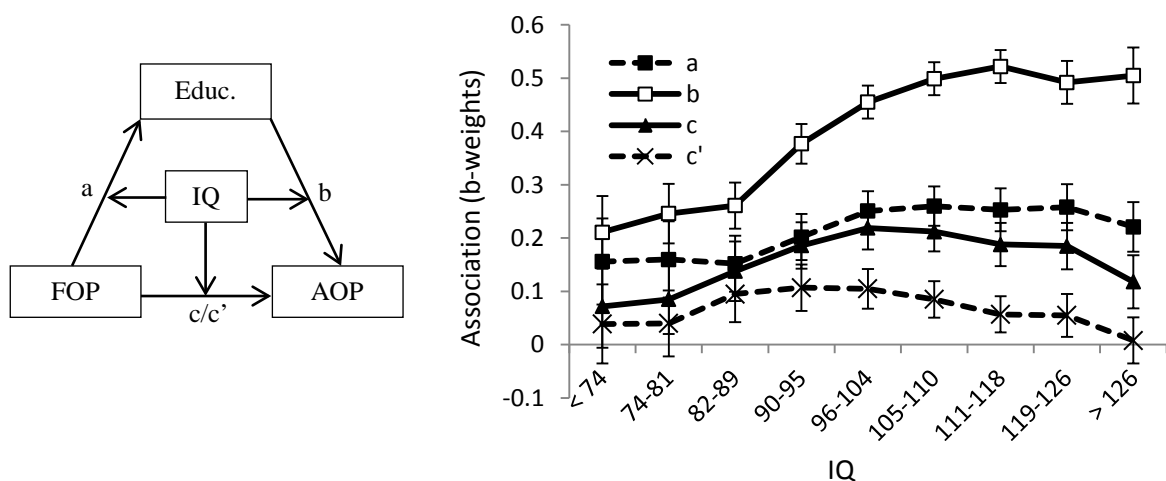
Note: In each column, if two values have a subscript in common, or if one of the values lack a subscript, the difference between the effects is not significant ($p > .001$).

As hypothesized, the importance of education as a mediator of the effect of social background on own attained occupational position increased with increasing intelligence. The size of the mediating effect ($a \times b$) depends upon, and increases with, the strength of the association between social background and level of education (a) and the association between education and own attained occupational position when adjusting for social background (b). In order to see which of these effects drive the association between intelligence and the mediating role of education, we plot the effects in Table 3 (Figure 1, Right panel). It is obvious that the association between education and own attained occupational position (b) increases more with increasing intelligence than the association between social background and education (a) or the crude, and adjusted, association between social background and own attained occupational position (c and c'). If we assume that the moderating effect of intelligence on these effects is due to the fact that social background and attained level of education are indicative of educational/occupational motivation, this difference might be seen

to indicate that motivation has a stronger association with level of education than with social background. This conclusion would concur with Schoon (2008), who found the correlation between school motivation and parental occupational position to vary between .10 and .19 in four British subsamples (men and women in two different cohorts) while the correlation between school motivation and attained level of education varied between .30 and .34 in the same subsamples. However, it should be stressed, again, that the assumption that social background and attained educational level are indicative of educational/occupational motivation in the present study is problematic and more direct measures of motivation would, of course, have been preferable.

Figure Legend

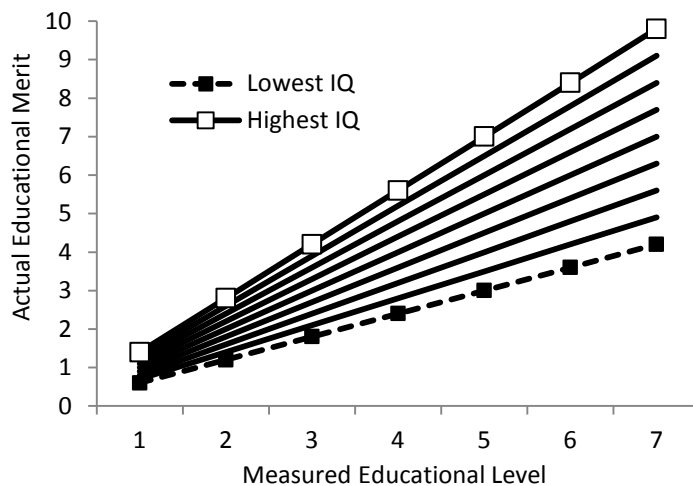
Figure 1. Left panel: The analyzed effects: (a) the crude effect of father's occupational position (FOP) on level of education; (b) the effect of education on own attained occupational position (AOP) when adjusting for father's occupational position; (c) the crude effect of father's occupational position on own attained occupational position; (c') the effect of father's occupational position on own attained occupational position when adjusting for level of education. How intelligence moderates these effects has also been analyzed. *Right panel:* The association between IQ and the strength of the associations (unstandardized b-weights) in the left panel. The error bars show the 99.9 % CI.



Intelligence was found to moderate the association between level of education and attained occupational position. However, a systematic variation in the validity of measured educational merit could be one possible confounder for this finding. Even if two persons have the same measured level of education, on our scale from one to seven, the actual educational merit could still differ between them, as some educational outcomes, even when graded at the same level, are more prestigious than others. Although a main effect of intelligence on the difference between measured level of education and actual educational merit could not explain the moderating effect of intelligence on the association between level of education and attained occupational position, it is possible that the association between measured educational level and actual educational merit is stronger for those with higher compared with lower measured intelligence (Figure 2). If we assume that it is actual educational merit, rather than measured educational level, that determine what occupational position people will attain, this could explain why the association between measured educational level and attained occupational level increases with increasing intelligence. However, we should stress that we do not know to what extent our measure of educational level lacks in validity and if this possible lack varies systematically with intelligence.

Figure Legend

Figure 2. A possible positive intelligence \times measured educational level interaction effect on actual educational merit. The lines represent nine levels of intelligence, from the lowest (bottom line) to the highest (top line).



Another possible confounder of the present findings is that education has a stronger effect on own attained occupational position at high compared with low levels, so that an increase in education from, for example, level 6 to level 7 is associated with a larger increase in own attained occupational position than an increase from level 1 to level 2. This would mean that the association between level of education and attained occupational level is exponential. Therefore, the association between level of education and own attained occupational position might be stronger among those with high intelligence, compared with those with lower intelligence, simply because they tend to have a higher level of education. This possibility is confirmed by a look at Table 5, which presents the effect of every increase in level of education by one step on own attained occupational position. While an increase in education from level 1 to level 2 is associated with an increase in own attained occupational position with .268 points, on the scale from 1 to 5, the corresponding value for an increase from level 6 to level 7 is .530 points. A look at these effects separately for the nine levels of intelligence reveals that at low levels (level 1-3) the effect of an increase in education on own attained occupational position increases with increasing intelligence (the linear trend is positive and significant, Table 5, last row) while the effect of an increase in education from level 4 to level 5 decreases with increasing intelligence.

Table 5

The Effect of One Steps Increase in Level of Education on Own Attained Occupational Position, Separately for the Different Levels of Intelligence. In the Last Row the Linear Trend (the Change in the Effect of Education on Own Attained Occupational Position for One Steps Increase in Level of Intelligence) is Given.

IQ	Increase in Level of Education					
	1-2	2-3	3-4	4-5	5-6	6-7
All	.268(.021)*	.247(.018)*	.646(.018)*	.790(.021)*	.605(.017)*	.530(.041)*
< 74	.090(.048) _{ab}	.055(.053) _{ab}	.618(.126)*	.971(.378) _{abc}	1.133(.544)	-
74-81	.169(.050) _{ab} *	.006(.050) _a	.287(.082)*	1.236(.146) _c *	.612(.251)	-
82-89	.049(.045) _a	.093(.041) _{ab}	.386(.057)*	1.028(.115) _c *	.524(.164)	-
90-95	.210(.044) _{ab} *	.130(.037) _{ab} *	.389(.046)*	.987(.076) _c *	.669(.091)*	.381(.691)
96-104	.234(.049) _{ab} *	.221(.039) _{ab} *	.478(.042)*	.853(.054) _c *	.532(.054)*	.755(.239)
105-110	.349(.069) _b *	.282(.047) _b *	.434(.041)*	.761(.045) _{bc} *	.569(.038)*	.595(.141)*
111-118	.445(.125) _b *	.262(.066) _{ab} *	.544(.048)*	.621(.045) _{ab} *	.566(.033)*	.620(.089)*
119-126	.332(.232) _{ab}	.377(.105) _b *	.435(.069)*	.511(.052) _a *	.619(.036)*	.449(.074)*
> 126	-.707(.661) _{ab}	.432(.218) _{ab}	.555(.117)*	.566(.066) _{ab} *	.481(.040)*	.430(.059)*
Lin.Tre.	.044(.012)*	.051(.010)*	.009(.010)	-.104(.013)*	-.017(.011)	-.064(.034)

* $p < .001$; Note: In each column, if two values have a subscript in common, or if one of the values lack a subscript, the difference between the effects is not significant ($p > .001$).

A look at the mean own attained occupational position for the seven levels of education, separately for those with low (< 90), average (90-110), and high (> 110) intelligence, indicates that with decreasing intelligence, the association between education and own attained occupational position becomes increasingly exponential (Figure 3). This notion is confirmed by a hierarchical regression analysis where the quadratic term of education is entered into the model after controlling for the linear term. While the addition of the quadratic term almost doubles the amount of variance in own attained occupational position that is

explained by the model for those with the lowest level of intelligence, the same addition contributes nothing for those with the highest level of intelligence (Table 6).

Figure Legend

Figure 3. The association between attained level of education and mean own attained occupational position (AOP), separately for those with low (< 90), average (90-110), and high (> 110) intelligence. The error bars show the 99.9 % CI.

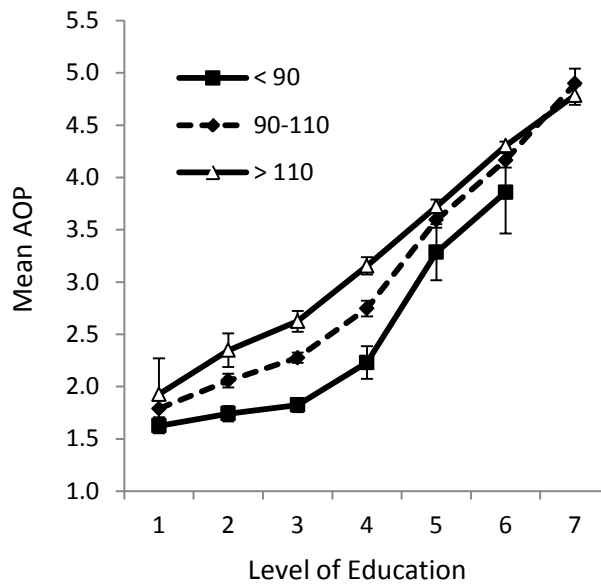


Table 6

Parameter Values for the Quadratic Model with Own Attained Occupational Position as Outcome and with Level of Education as Predictor, Separately for the Different Levels of Intelligence. In the Last Row the Linear Trend for the Quadratic Term is Given. The Three Rightmost Columns Present the Amount of Variance in Own Attained Occupational Position that can be Explained (R^2) by the Linear and the Quadratic Effects of Education and how Much the Amount of Explained Variance Increases when Adding the Quadratic Term.

IQ	Parameters			R^2		
	Intercept	Education	Education ²	Linear	Quadratic	Change
All	1.550(.030)*	.064(.017)*	.065(.002)*	.378*	.392*	.014*
< 74	1.858(.089)*	-.512(.077)*	.152(.015)*	.074*	.145*	.070*

74-81	1.909(.089)*	-.393(.069)*	.121(.012)*	.094*	.141*	.047*
82-89	2.068(.078)*	-.388(.057)*	.115(.010)*	.081*	.119*	.038*
90-95	1.977(.074)*	-.271(.048)*	.106(.007)*	.167*	.200*	.033*
96-104	1.845(.078)*	-.082(.047)	.079(.006)*	.237*	.255*	.018*
105-110	1.767(.094)*	.065(.051)	.058(.006)*	.290*	.299*	.008*
111-118	1.691(.127)*	.189(.064)	.041(.008)*	.309*	.313*	.004*
119-126	1.794(.177)*	.217(.083)	.033(.009)*	.281*	.283*	.002*
> 126	1.235(.294)*	.523(.124)*	-.001(.013)	.268*	.268*	.000
Lin.Tre.			-.018(.001)*			

The lack of a clear association between intelligence and the effect of education on own attained occupational position when analyzing the effect of an increased level of education step by step (Table 5), and that the association between level of education and own attained occupational position is more linear for those with high intelligence and more exponential for those with low intelligence (Figure 3 and Table 6), are not findings that easily could have been predicted from a combination of theories about an ability \times motivation interaction effect on performance and an assumption that level of education is indicative of educational/occupational motivation. Therefore, the main findings of the present study, that intelligence moderates the mediating role of education for the association between social background and own attained occupational position, mainly because the association between level of education and own attained occupational position strengthens with increasing intelligence, might be due to some other factors than a positive ability \times motivation interaction effect on performance.

Figure 3 indicates that the effect of intelligence on own attained occupational position might be strongest for those with an intermediate level of education and weaker for those with a low or a high level of education. This suspicion is confirmed by the presented effects in Table 7, which show that the effect of intelligence on own attained occupational position is a

curvilinear (inverted U) function of level of education. If our assumption that level of education is indicative of a high educational/occupational motivation and the theories about a positive ability \times motivation interaction effect on performance are correct, we should instead have seen that the effect of intelligence on own attained occupational position increases linearly with increasing level of education.

Table 7

The Unstandardized Effect of Intelligence on Own Attained Occupational Position, Separately for the Different Levels of Education.

1	2	3	4	5	6	7
.074(.010) _{ab} *	.117(.008) _b *	.163(.006) _c *	.169(.009) _c *	.066(.009) _a *	.054(.007) _a *	-.050(.021) _a

* $p < .001$; Note: If two values have a subscript in common the difference between the effects is not significant ($p > .001$).

One possible reason for this deviation from the expected association might be a three way interaction between level of education, received intelligence score, and the validity of measured intelligence. One might assume that high intelligence is necessary, but not sufficient, in order to achieve a high score on an intelligence test. Some of the present subjects might have received a low score at the conscription due to temporary factors, such as illness, or maybe because they have strived for a low measurement of intelligence in order to avoid the officers' longer military service. In accordance with the presented theories (e.g. Vroom, 1964), such lack of motivation should weaken the association between actual intelligence and the performance on an intelligence test. William-Olsson (1972) found that subjects tended to increase their result on the intelligence test at a retest compared with the result at the conscription. This was especially true for those who received a low score at the conscription. One might suspect that this possible lack of validity in the measurement of intelligence at conscription would be especially large among those subjects who, in spite of their low

intelligence score, go on and attain a high level of education. These men possibly have an actual intelligence that is, more or less, on par with the intelligence of those men who, like themselves, attain a high level of education but who also achieved a high intelligence score at the conscription.

Taken together, although the results from these detailed analyses (Tables 5-7, Figure 3) do not fit well with our hypothesis about an ability \times motivation interaction effect on performance, where motivation is operationalized as level of education and performance as own attained occupational position, both the underlying theories and these operationalizations might be correct/valid, and the fault might instead lay with a relatively low validity in the measurement of intelligence among men who receive a low score at conscription but who, nonetheless, go on and attain a high level of education. It is possible that the exponential association between level of education and own attained occupational position, seen among those with a low intelligence score, is due to the fact that among these men an increase in level of education means both an increase in level of education and an increase in actual intelligence. Among men with a high intelligence score, on the other hand, an increase in level of education means ‘only’ an increase in level of education, and the association between level of education and own attained occupational position remains linear.

Conclusions

In the present cohort of Swedish men it was found that: (1) The importance of education as a mediator of the effect of social background on own attained occupational position increases with increasing intelligence; (2) This moderating effect of intelligence is mainly due to the fact that the association between attained level of education and own attained occupational position strengthens with increasing intelligence. Although these general findings concur with the hypothesis, based on theories about a positive ability \times motivation interaction effect on performance and assumptions that attained level of education can be used as a measure of motivation and own attained occupational position as a measure of

performance, the results from more detailed analyses did not concur with the hypothesis. One possible culprit might be a low validity in the measurement of intelligence among those men who receive a low intelligence score at conscription but who, nonetheless, go on and attain a high level of education. This would, actually, be in line with the theories about a positive ability \times motivation interaction effect on performance that underlie the original research hypothesis. In a wider context, the present findings and discussion indicate that we should not take the validity of a low ability score for granted, especially if a proven high ability could have some negative consequences.

References

- Arbuckle, J. L. (2011). *IBM SPSS Amos 20 user's guide*. IBM Corp.
- Ball, R. S. (1938). The predictability of occupational level from intelligence. *Journal of Consulting Psychology*, 2, 184–186.
- Blau, P. M., & Duncan, O. D. (1967). *The American occupational structure*. New York: The Free Press.
- Breen, R., & Goldthorpe, J. H. (1999). Class inequality and meritocracy: A critique of Saunders and an alternative analysis. *British Journal of Sociology*, 50, 1-27.
- Breen, R., & Goldthorpe, J. H. (2001). Class, mobility and merit: The experience of two British birth cohorts. *European Sociological Review*, 17, 81-101.
- Campbell, J. P. (1990). Modeling the performance prediction problem in industrial and organizational psychology. In M. D. Dunnette & L. Hough (Eds.), *Handbook of industrial and organizational psychology* (pp. 687-732). Palo Alto, CA: Consulting Psychologists Press.
- Carlstedt, B. (2000). *Cognitive abilities: Aspects of structure, process, and measurement*. Gothenburg: ACTA Universitatis Gothoburgensis.
- Deary, I. J., Taylor, M. D., Hart, C. L., Wilson, V., Davey Smith, G., Blane, D., et al. (2005). Intergenerational social mobility and the mid-life status attainment: Influences of childhood intelligence, childhood social factors, and education. *Intelligence*, 33, 455-472.
- Ganzach, Y., Saporta, I., & Weber, Y. (2000). Interaction in linear versus logistic models: A substantive illustration using the relationship between motivation, ability, and performance. *Organizational Research Methods*, 3, 237-253.
- Härkönen, J., & Bihagen, E. (2011). Occupational attainment and career progression in Sweden. *European Societies*, 13, 451-479.

- Herrnstein, R. J., & Murray, C. (1994). *The bell curve: Intelligence and class structure in American life*. New York: Free Press Paperbacks.
- Hirschfeld, R. R., Lawson, L., & Mossholder, K. W. (2004). Moderators of the relationship between cognitive ability and performance: General versus context-specific achievement motivation. *Journal of Applied Social Psychology*, 34, 2389-2409.
- Ishida, H., Müller, W., & Ridge, J. M. (1995). Class origin, class destination, and education: A cross-national study of ten industrial nations. *American Journal of Sociology*, 101, 145-193.
- Johnson, W., Brett, C. E., & Deary, I. J. (2010). The pivotal role of education in the association between ability and social class attainment: A look across three generations. *Intelligence*, 38, 55-65.
- McCall, R. B. (1977). Childhood IQ's as predictors of adult educational and occupational status. *Science*, 197, 482-483.
- McCloy, R. A., Campbell, J. P., & Cudeck, R. (1994). A confirmatory test of a model of performance determinants. *Journal of Applied Psychology*, 79, 493-505.
- Nettle, D. (2003). Intelligence and class mobility in the British population. *British Journal of Psychology*, 94, 551-561.
- R Core Team (2012). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL <http://www.R-project.org/>.
- Ross, A. (1988). *De värnpliktigas prestationsförmåga vid inskrivningspövningar i Sverige 1969-1979 [The conscripts' capacity at enlistment testing in Sweden 1969-1979]*. Umeå: Umeå Universitet, Pedagogiska Institutionen.
- Sackett, P. R., Gruys, M. L., & Ellingson, J. E. (1998). Ability-personality interactions when predicting job performance. *Journal of Applied Psychology*, 83, 545-556.

- Schmidt, A. M., & DeShon, R. P. (2007). What to do? The effects of discrepancies, incentives, and time on dynamic goal prioritization. *Journal of Applied Psychology, 92*, 928-941.
- Schmidt, A. M., & Dolis, C. M. (2009). Something's got to give: The effects of dual-goal difficulty, goal progress, and expectancies on resource allocation. *Journal of Applied Psychology, 94*, 678-691.
- Schmidt, A. M., Dolis, C. M., & Tolli, A. P. (2009). A matter of time: Individual differences, contextual dynamics, and goal progress effects on multiple-goal self-regulation. . *Journal of Applied Psychology, 94*, 692-709.
- Schoon, I. (2008). A transgenerational model of status attainment: The potential mediating role of school motivation and education. *National Institute Economic Review, 205*, 72-82.
- Sorjonen, K., Hemmingsson, T., Lundin, A., Falkstedt, D., & Melin, B. (2012). Intelligence, socioeconomic background, emotional capacity, and level of education as predictors of attained socioeconomic position in a cohort of Swedish men. *Intelligence, 40*, 269-277.
- Strenze, T. (2007). Intelligence and socioeconomic success: A meta-analytic review of longitudinal research. *Intelligence, 35*, 401-426.
- von Stumm, S., Macintyre, S., Batty, D. G., Clark, H., & Deary, I. J. (2010). Intelligence, social class of origin, childhood behavior disturbance and education as predictors of status attainment in midlife in men: The Aberdeen Children of the 1950s study. *Intelligence, 38*, 202-211.
- Vroom, V. H. (1964). *Work and motivation*. New York: John Wiley and Sons.
- Warren, J. R., Hauser, R. M., & Sheridan, J. T. (2002). Occupational stratification across the life course: Evidence from the Wisconsin longitudinal study. *American Sociological Review, 67*, 432-455.

- William-Olsson, U. (1972). *Arbetsanalys av värnpliktiga befattningar [Working analysis of conscripts' positions]*. Stockholm: Militärpsykologiska Institutet.
- Yeo, G. B., & Neal, A. (2004). A multilevel analysis of effort, practice, and performance: Effects of ability, conscientiousness, and goal orientation. *Journal of Applied Psychology*, 89, 231-247.

Author Note

The work was partly undertaken in The University of Edinburgh Centre for Cognitive Ageing and Cognitive Epidemiology, part of the cross council Lifelong Health and Wellbeing Initiative (G0700704/84698). Funding from the Biotechnology and Biological Sciences Research Council (BBSRC), Engineering and Physical Sciences Research Council (EPSRC), Economic and Social Research Council (ESRC) and Medical Research Council (MRC) is gratefully acknowledged.

Correspondence concerning this manuscript should be addressed to: Kimmo Sorjonen, Karolinska Institutet, Department of Clinical Neuroscience, Division of Psychology (Nobels väg 9), 171 65 Solna, Sweden, E-mail: kimmo.sorjonen@ki.se, Phone: + 46 – 8 – 524 824 44.